Rapid response to the discovery of olive hymenachne (*Hymenachne amplexicaulis* (Rudge) Nees) on Rinyirru (Lakefield) National Park

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Summary Olive hymenachne, a Weed of National Significance, was found for the first time on Rinyirru (Lakefield) National Park in February 2011. The response by Queensland Parks and Wildlife Service has been rapid and thorough. Circumstantial evidence suggests that the plant may have reached the park by bird dispersal from a source outside the park. The current extent of the infestation has been delimited at high resolution and an integrated control program, with the aim of eradicating the species from the national park, has commenced. The steps being taken towards this end are outlined and discussed. This response aligns with the goal of eradication from Cape York Peninsula outlined in the national zoning strategy for this species. The success of the program may depend more on solving logistical problems associated with accessing populations year round than any other issue.

Keywords *Hymenachne amplexicaulis*, olive hymenachne, olive, eradication.

INTRODUCTION

Hymenachne amplexicaulis (Rudge) Nees, commonly known as hymenachne, olive hymenachne or simply olive, was introduced into Australia as seed from Venezuela in 1973 (Oram 1989) and actively promoted throughout the 1980s and 1990s as a cattle fodder for ponded pastures and wet areas in Queensland and the Northern Territory (Csurhes *et al*. 1999). Given its weedy traits and the fact that it grows well in water, it was not long before concerns about its potential to spread away from places where it was planted were realised (Clarkson 1991, Csurhes *et al*. 1999). It now infests wetlands and waterways across coastal and sub-coastal parts of the Northern Territory, Queensland and northern New South Wales and has the potential to spread well beyond this (Wearne *et al*. in press). In 1999, it was listed as one of Australia's twenty Weeds of National Significance and is a declared pest plant in all mainland states and territories (DNRMW 2006).

Queensland Parks and Wildlife Service (QPWS) was aware of olive hymenachne on pastoral properties within the catchment of Rinyirru (Lakefield) National Park (RLNP) but its presence on the park was only confirmed in February 2011 (Dollery and Clarkson 2011). Given the diversity of wetland communities on RLNP and the known impacts of olive hymenachne across its current range, the threat posed by this species to the values of the national park is not being underestimated by QPWS. The initial response, which is attempting to eradicate the species from RLNP, has been rapid and thorough and is consistent with the strategic objectives outlined in the national zoning strategy for the species (Grice *et al*. 2011). In this paper we discuss the discovery, delimitation and initial response to this incursion.

BACKGROUND

Discovery With olive hymenachne known to occur within the catchment of at least two river systems flowing into RLNP, a major effort had been made over many years to ensure that staff working in, or regularly visiting, the park were familiar with the plant and were fully aware of the risk that it might one day spread to the park. Signage had also been erected at strategic places throughout the park asking visitors to report any suspicious plants. It was thought that if olive hymenachne was to spread to the park, it would be most likely to do so by seeds or plant fragments being dispersed by water down rivers and across floodplains in those catchments in which it occurred. It was presumed that the plant would appear first at or near the park boundary and spread progressively down stream. It therefore came as some surprise when the plant was found in Red Lily Lagoon on 16 February 2011 during aerial pig shooting operations. This lagoon is more than 40 km inside the park boundary. Although the staff member who found the plant was in no doubt as to its identity, confirmation by a departmental botanist was sought and obtained within two days of the discovery.

Delimitation and initial response The discovery of olive hymenachne on the park suggested a survey of other wetlands on RLNP was warranted but, before this could be undertaken, a large infestation was discovered in a swamp 5 km south of Red Lily Lagoon on 19 April 2011. Once again this was an incidental

discovery by a staff member involved in unrelated aerial work. This prompted an immediate helicopter survey that focussed on wetlands between the Kennedy and Normanby rivers (Figure 1) extending 10 km north and south of the Lakefield ranger base. Infestations ranging in size from single plants to well established patches as large as 10 ha, were located in five wetlands.

On 5 May 2011, a further aerial survey was combined with helicopter mounted boom spraying of the populations identified on April 19. This extended the area searched by a further 15 km to the north and 25 km to the south. More plants were located, bringing the total number of wetlands with olive hymenachne to eleven. Additional populations (patches) were also located in some wetlands already known to be infested. All populations previously known, or detected on this flight, were aerially sprayed with glyphosate (Minor Use Permit PER 11541) in an attempt to suppress seed set. Subsequent ground observations suggested flowering may have been too far advanced for this to have been achieved in all cases.

A further wider ranging aerial survey was conducted over three days from 18 to 20 June 2011. These flights were primarily designed to determine how olive hymenachne might have spread into the park and to rule out the presence of infestations beyond the eleven infested wetlands. For this reason, flights concentrated on the riparian corridors of the Normanby, Laura, Hann and Kennedy rivers and major wetlands associated with these streams. These systems flow from grazing properties known to carry planted sources of olive hymenachne. No new infestations were found but, once again, previously unrecorded patches were located in wetlands known to harbour the plant.

By the end of June, the number of infested wetlands remained at eleven (Figure 1). These were roughly centred on the Lakefield ranger base and had a north to south extent of just over 20 km. All were located in the narrow corridor between the Normanby and North Kennedy rivers. Populations in many wetlands were scattered, small and roughly circular in shape. These were probably single plants recently derived from one propagule (a single seed or one plant fragment) and a single dispersal event. However, the size, shape and extent of the populations in at least two wetlands suggested the plant may have been present, but undetected, in the national park for some time. While it is not possible to positively describe how olive hymenachne got to RLNP, or when this might have happened, the pattern of infestation observed suggests that birds, such as magpie geese, may have carried seed from a source beyond the park boundary.

Biology and control options The biology and ecology of olive hymenachne is reasonably well understood (Wearne *et al*. 2010). Characters related to dispersal and to flowering and seeding have the greatest potential to influence the success of efforts to eradicate the plant from RLNP. Plants flower and set seed towards the end of the wet season when ground access to many parts of the national park is all but impossible and the wetlands are at full capacity. Innovative ways will need to be developed to overcome these potential barriers to success. Further seeding must be prevented if eradication is to be achieved and, as experimental evidence suggests buried seed can remain viable for at least eight years (Wearne *et al*. 2010), the control program must continue long after the last seeding plant is removed.

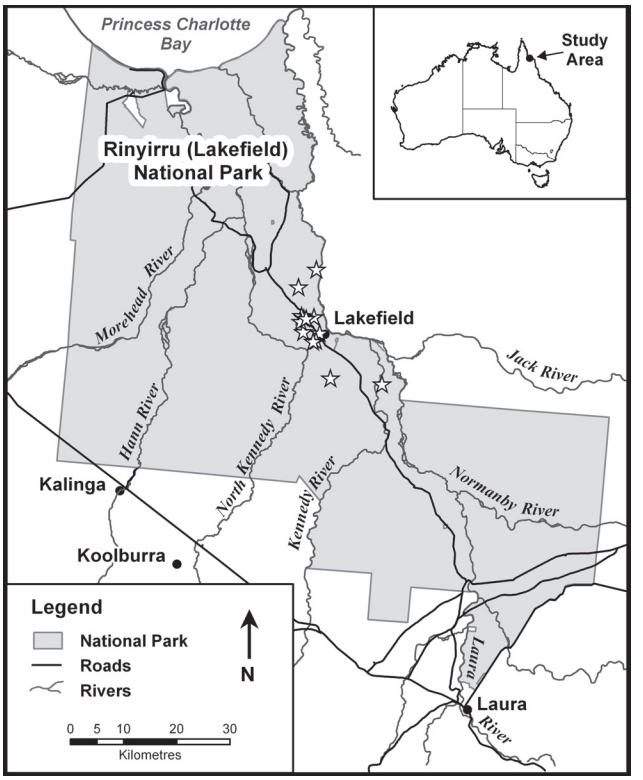

Figure 1. Map of Rinyirru (Lakefield) National Park. Stars indicate infested wetlands located by the end of March 2012.

Effective control methods are limited but local eradication has been shown to be possible if populations are found early, as appears to be the case here, and the response is rapid and sustained. Only two herbicides, glyphosate and haloxyfop, are registered for control of the plant. The use of these herbicides in Queensland is permitted under minor use permits PER 11541 and PER 11540 respectively. Both have the potential to cause off-target damage. Haloxyfop has been shown to be more effective than glyphosate, particularly when plants are growing in deep water. However, most populations on RLNP will have to be sprayed from the air if they are to be treated before flowering, and haloxyfop is not currently registered for aerial application. Biosecurity Queensland has applied to have the current minor use permit (PER 11540), which allows ground application only, amended to allow application from the air (David Holdom, pers. comm.).

As with most invasive plants, an integrated and sustained effort is more likely succeed than one which relies solely on a single control method. While fire alone will not kill olive hymenachne, it can play an important part in an integrated control program. Following herbicide application, fire can be used to remove dead biomass and expose seedlings and reshoots for follow up spraying. Burning is particularly useful if fires can be lit before the substrate dries out, or even while the sprayed plant material is still lying in shallow water. Under these conditions, a second germination event can be triggered, thus accelerating the depletion of the soil seed bank. Plants can be killed by covering with weed matting but this is only suitable for relatively small areas and may be difficult to deploy.

Logistics RLNP experiences a strongly seasonal wet/dry climate. At the height of the wet season ground-based movement on the park is all but impossible. The success of the control program will probably rest more on solving the logistical problems associated with accessing populations of the weed year round than any other single factor. If the problems associated with getting to infested wetlands at the height of the wet season in February and March cannot be overcome, eradication will almost certainly fail. However, getting to the wetland is just the first step. It is then essential that all plants are treated with an effective herbicide, applied in sufficient volume, and in a manner guaranteed to kill all plants. This will be a difficult task and one that cannot be achieved with the technology currently available on the park. The ever present danger posed by the presence of large estuarine crocodiles will also restrict control options. This is not an issue weed control programs in temperate areas of Australasia have to address.

Aerial spraying from helicopters will play an important role, but off-target damage associated with the application of glyphosate by boom spray may be unacceptable, especially if this is repeated over a number of years. However, because aquatic systems can be very resilient, the current infestation is reasonably small, and there are few other seriously invasive aquatic plants present on RLNP, the risk of irreversible off-target damage at this early stage in the invasion is probably acceptably low. Nevertheless the potential benefits of continued aerial application of a non selective herbicide to the same wetland over a number of years by boom spray must be carefully weighed against the environmental costs before this practice becomes an integral part of the control program. The use of shrouded nozzles may provide an acceptable compromise. This technology can apply herbicides with much greater precision than boom sprays and could help minimise off-target damage. These units have been employed with some success in the control of pampas grass in difficult conservation sites in New Zealand (Popay *et al*. 2003).

DISCUSSION

Weed management plan It is fortunate that olive hymenachne appears to still be in the early stages of invasion on RLNP. Eradication from the park might be achievable. However, success will require strict adherence to a closely managed response plan. A two-year weed management plan with the goal of eradication of olive hymenachne from RLNP has been prepared and is being implemented. The key to this plan is the management of olive hymenachne at the population (patch) scale not as whole wetlands. The plan calls for frequent review of progress towards the goal of eradication and the resetting of clear and realistic goals at the end of the initial two year program.

It is important to point out that should attempts at eradication fail, containment in the sense defined by Grice *et al*. (2012) is not a viable fall back position for this species. In locations such as RLNP, preventing spread of olive hymenachne, once it becomes well established, is probably all but impossible. If the plant becomes well established, it will almost certainly spread to many wetlands across the park. It will be impossible to deal with the plant at this scale and it may be necessary to abandon some wetlands in favour of concentrating efforts on minimising the impacts in others. In anticipation of this as a possible outcome, it is important that the key wetlands are identified ahead of any decision to abandon eradication efforts.

Progress to date As the 2011 dry season progressed and access to wetlands with known populations of olive hymenachne became possible, these were searched and individual patches of Olive hymenachne located by GPS and marked with a steel picket. At the same time, the patches, plus a 5–10 m buffer beyond the outermost plants, were sprayed by handgun with haloxyfop (520 g L^{-1}) at a mix rate of 50 mL chemical to 100 L of water. Bonus™ was used as a spray adjuvant. Sites were revisited when plants had died and dried sufficiently to burn. Following the fire, patches were monitored for seedling emergence or regrowth from stem fragments and retreated with haloxyfop if this occurred. By the onset of the wet season in mid- January 2012, all patches had been visited and treated in this way at least once. After initial herbicide treatment, a permeable, UV-stabilised, weed blocking fabric was spread over one patch to test how effective this might be at suppressing germination.

In March 2012, two days of helicopter survey were flown. This concentrated on wetlands within the delimited extent of the infestation. New patches were found in wetlands known to contain olive hymenachne but only two wetlands, where the plant was not previously known, were found. Subsequent ground inspection suggested these might have been present prior to the wet season and not identified thus highlighting the difficulty of locating plants when they are small.

All known populations were sprayed with glyphosate applied from a helicopter-mounted boom on 2 April 2012. Follow-up aerial spraying was carried out 49 days later when the results of the first application were obvious from the air.

One year into the initial two-year weed management program, staff are cautiously optimistic that local eradication can be achieved. Despite the discovery of olive hymenachne in two wetlands thought to be free of the plant, an overall reduction of approximately 50–60% of the known stands appears to have been achieved. Results have been most promising in those wetlands which dry out as the year progresses.

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